PATENT ABSTRACTS OF JAPAN

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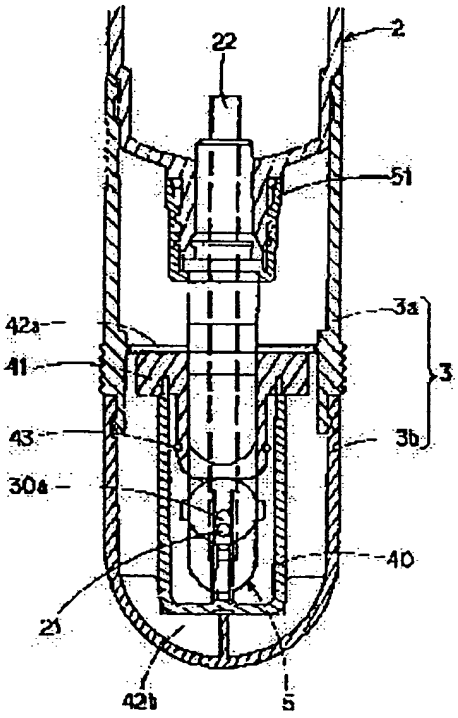
(54) PORTABLE MEASURING INSTRUMENT

(57)Abstract:
PURPOSE: To provide a portable measuring instrument in which the size is reduced, the operability is improved, the output stability is improved and waterproofness is improved.
CONSTITUTION: A sensor holder 5 which contains a planar type enzyme sensor formed integrally with a substrate electrode and an immobilized enzyme film is detachably mounted at a measuring instrument body 2, a conical opening 30a corresponding to the sensing part 21 of the sensor is provided at the holder 5, a cartridge 40 and a packing member 41 are provided in a cover 3 detachably mounted at the body 2, stock solution is contained in the inner space formed of the cartridge 40 and the member 41, and the holder 5 is dipped in the solution in the cover 3 via the member 41.



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CLAIMS

[Claim(s)]

[Claim 1] It is the carried type measuring instrument characterized by to consist of covering characterized by providing the following, for the aforementioned covering to connote preservation liquid in the closed space formed by the cartridge prepared in the interior, and the packing member, and for the aforementioned sensor electrode holder to penetrate a packing member, to be inserted into covering, and for the enzyme sensor in a sensor electrode holder to touch the preservation liquid in covering by this. The main part of a measuring instrument equipped with the sensor electrode holder, measuring circuit, and power supply section which built in the enzyme sensor. The preservation liquid stowage which is attached in the main part of a measuring instrument removable so that the enzyme sensor which projects from this main part of a measuring instrument may be covered, and contains the preservation liquid for enzyme sensors.

[Claim 2] It is the carried type measuring instrument according to claim 1 which it comes to carry out 2 ****s of the aforementioned coverings, and is characterized by for the desorption of the aforementioned cartridge and the packing member being carried out by division of covering, and fixing fixation of divided covering automatically in covering.

[Claim 3] The aforementioned enzyme sensor is a carried type measuring instrument according to claim 1 or 2 characterized by being the planar type enzyme sensor which formed the hydrogen peroxide electrode on the insulating substrate, and formed the immobilized-enzyme layer on this hydrogen peroxide electrode.

[Claim 4] The aforementioned enzyme sensor is a carried type measuring instrument according to claim 1, 2, or 3 characterized by being contained with a surface-protection film in the aforementioned sensor electrode holder.

[Claim 5] The aforementioned surface-protection film is a carried type measuring instrument according to claim 4 characterized by being fixed to the O ring formed in the aforementioned sensor electrode holder, and carrying out adhesion fixation at an enzyme sensor at the time of receipt of the aforementioned enzyme sensor into a sensor electrode holder.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] this invention relates to the carried type measuring instrument for biochemistry which used the immobilized-enzyme sensor.
[0002]
[Description of the Prior Art] An enzyme can use it now by the outstanding substrate specificity and outstanding immobilization technology, being stabilized repeatedly, utilization is promoted, and, as for the present age, the food-stuff-industry field, the clinical test field, etc. are used broadly. In the inspection field, it is used for detection and the fixed quantity of the special material in the composite sample using the enzyme, and two kinds of methods as follows are mainly put in practical use. The one method is the method of changing the amount of enzyme reactions into color tone change by mixture with an enzyme and a color reagent, detecting this color tone change optically, and measuring special material (substrate), and other methods are the methods of detecting electrochemically an enzyme and the matter fluctuated in connection with an enzyme reaction combining an electrode, and measuring special material (substrate) from the quantity of electricity change.
[0003]
[Problem(s) to be Solved by the Invention] Although in the case of the latter method it may mix with the sample solution and an enzyme may be used, since equipment becomes large-scale, the combination of fixation and thin-film-izing of the enzyme which can miniaturize equipment for general uses, and an electrode is used. In this case, it is necessary to keep constant an immobilized-enzyme film and the both sides of adhesion of an electrode, and the damp or wet condition of the sensor section.
[0004] This is for keeping constant the diffusing capacity to the immobilized-enzyme layer of the measuring object matter in a liquid sample (substrate), and the diffusing capacity on the front face of an electrode of the matter fluctuated in connection with an enzyme reaction, and stabilizing a measurement result. On the contrary, when the damp or wet condition of an enzyme film, the adhesion of an electrode and an enzyme film, and an electrode changes, it is to change a measurement result as a result. Then, although the attempt of the improvement in operability, such as forming an enzyme film wearing fixture, is made in order to maintain uniformly the electrode at the time of enzyme film wearing, and the adhesion of an enzyme film, in order that a user may exchange until it gets tired, the adhesion instability by poor wearing is not avoided.
[0005] Moreover, in order to maintain the immobilized-enzyme sensor section at a fixed damp or wet condition, the method of preparing the sensor section in a flow cell and supplying a sample and preservation liquid has been used, and a pump is also needed in addition to a flow cell. Anyway, for maintenance of waterproofing and preservation liquid, equipment became large and became expensive. Moreover, the constant rate needed to be isolated preparatively also about the sample, and the sensor needed to be supplied, or the sample needed to be brought together in the container, the sensor needed to be immersed, and the pretreatment treatment of a sample was required.

[0006] On the other hand, the disposal which maintains the damp or wet condition of an enzyme sensor is made by making a sponge-like porosity object absorb preservation liquid, and contacting this porosity object on the induction front face of an immobilized-enzyme sensor in recent years (for example, refer to JP,4-43947,A and JP,64-50,U). In this case, although portability improved by miniaturization, the diffusion limit film is separated, it is necessary to attach a diffusion limit film for every measurement, and it cannot be said that operability and stability are enough. Furthermore, the pressure-welding state of an electrode and a water absorption object tends to change with elastic change of an elasticity water absorption object, circulation of preservation liquid is also hard to be performed, and receipt volume also decreases. Moreover, it will be in a seal state at the time of preservation, and the pressure variation by the temperature change etc. will produce it.

[0007] Therefore, this invention was made paying attention to the above conventional troubles, and aims at offering the carried type measuring instrument which mainly realizes miniaturization, improvement in operability, improvement in output stability, and waterproof improvement.

[0008]

[Means for Solving the Problem] In order to attain the aforementioned purpose, the carried type measuring instrument of this invention according to claim 1 The main part of a measuring instrument equipped with the sensor electrode holder, measuring circuit, and power supply section which built in the enzyme sensor, It is attached in the main part of a measuring instrument removable so that the enzyme sensor which projects from this main part of a measuring instrument may be covered. It consists of covering equipped with the preservation liquid stowage which contains the preservation liquid for enzyme sensors. The aforementioned covering connotes preservation liquid in the closed space formed by the cartridge prepared in the interior, and the packing member. The aforementioned sensor electrode holder penetrates a packing member, is inserted into covering, and, thereby, is characterized by touching the preservation liquid in covering of the enzyme sensor in a sensor electrode holder.

[0009]

[Function] In a measuring instrument according to claim 1, if a sensor electrode holder (namely, enzyme sensor) appears, and it will be in a measurable state, if covering is removed from the main part of a measuring instrument at the time of measurement, and covering is conversely attached in the main part of a measuring instrument, an enzyme sensor is not only maintainable to a fixed damp or wet condition, but it can be immersed into the preservation liquid in covering of an enzyme sensor, and operability will improve.

[0010] It comes to carry out 2 ****s of coverings, and a cartridge and a packing member can take out a cartridge independently in the state of a power supply OFF by supposing that desorption is carried out by division of covering and fixation of divided covering is automatically fixed in covering (claim 2 publication). Therefore, it is advantageous at safety aspects, such as prevention of addition and exchange of preservation liquid, and washing of a cartridge not only being performed easily but a short circuit.

[0011] It becomes possible to make the enzyme reaction to a sample perform efficiently by being the planar type enzyme sensor by which the enzyme sensor formed the hydrogen peroxide electrode on the insulating substrate, and formed the immobilized-enzyme layer on this hydrogen peroxide electrode (claim 3 publication). Moreover, it becomes possible to process easily the form of the enzyme sensor according to the purpose of a measuring instrument. By containing an enzyme sensor with a surface-protection film in a sensor electrode holder (claim 4 publication), it is possible to be able to protect an enzyme sensor from the physical shock from the outside, and to protract the life of an enzyme sensor. Moreover, with a surface-protection film, the buffer matter which affects an enzyme reaction can be filtered and stable and exact measurement is attained.

[0012] It is fixed to the O ring formed in the sensor electrode holder, and by carrying out adhesion fixation at an enzyme sensor at the time of receipt of the enzyme sensor into a sensor electrode holder (claim 5 publication), the degree of adhesion of a surface-protection film to an enzyme sensor becomes always fixed, and the stable measurement of a surface-protection film is attained. Moreover, the waterproofing operation inside an enzyme sensor is obtained by using an O ring, and reinforcement of an

enzyme sensor and stabilization can be realized. Furthermore, since the C ing has these two work, it can realize stabilization of an enzyme sensor with easy structure.

[0013] By the above, it becomes the good carried type measuring instrument of the operability and reliability which turned a miniaturization and lightweight as a whole.

[0014]

[Example] Hereafter, the carried type measuring instrument of this invention is explained based on an example. The exterior side view of the measuring instrument concerning the one example is shown in drawing 1 , and an appearance side elevation is shown in drawing 2 . This measuring instrument 1 is attached in the main part 2 of a measuring instrument removable so that the sensor electrode holder which projects from the main part 2 of a measuring instrument equipped with the sensor electrode holder, measuring circuit, and power supply section which built in the enzyme sensor, and this main part 2 of a measuring instrument may be covered, and it consists of covering 3 equipped with the preservation liquid stowage which contains the preservation liquid for enzyme sensors. The main part 2 of a measuring instrument has a display 6 and the cell case 7, and an internal measuring circuit consists of electronic parts, such as a computing element and a buzzer, including various kinds. Moreover, if covering 3 is removed from the main part 2 of a measuring instrument as shown in drawing 3 and drawing 4 , the sensor electrode holder 5 which built in the enzyme sensor will appear from the main part 2 of a measuring instrument.

[0015] The enzyme sensor built in the sensor electrode holder 5 is the unification planar type enzyme sensor 18 which consists of a ground electrode 10 attached in the sensor electrode holder 5 as shown in drawing 5 , and an immobilized-enzyme film 13 by which the laminating was carried out on this ground electrode 10. Two example ** of a degree and ** are mentioned as a ground electrode 10.

** Voltage -> use the field-effect transistor as a current sensing element. In this case, the insulated gate section is prepared in the outermost part, an immobilized-enzyme layer is formed after the exterior, and pH change accompanying an enzyme reaction is caught as gate-voltage change (simultaneously changed into drain current change).

** Current -> use planar type an oxygen electrode and a hydrogen peroxide electrode as a voltage sensing element. In this case, an immobilized-enzyme layer is formed in an induction section front face, and the change in oxygen and the hydrogen peroxide accompanying an enzyme reaction is caught as oxidation-current change of a ground electrode. Although various kinds of metals are used as an electrode, gold (Au), platinum (Pt), silver (Ag), etc. are mainly used for a reference pole pair pole, using platinum (Pt) as an operation pole.

[0016] The following ** - ** are illustrated as an enzyme used for an enzyme sensor 18.

** Glucose oxidizing enzyme (GOD)

It is accompanied by consumption (reduction) of 2OGlucose+O2 -> gluconic-acid +H2 oxygen (O2), generating (increase) of a hydrogen peroxide (H2 O2), and generating (pH reduction) of a gluconic acid.

** Lactic-acid oxidizing enzyme (LOD)

It is accompanied by consumption (reduction) of 2OL-Lactate+O2 -> Pyruvate+H2 oxygen (O2), and generating (increase) of a hydrogen peroxide (H2 O2).

** Generating (increase in pH by reduction in hydrogen ion concentration) and CO2 of urease urea +H2 O->2NH3+CO2 ammonia It is accompanied by the increase in gas.

** It is accompanied by consumption (reduction) of uricase uric-acid +O2+2H2 O-> allantoin +H2 O+CO2 oxygen (O2), generating (increase) of a hydrogen peroxide (H2 O2), and the increase in CO2 gas.

[0017] The sandwich structure from which the immobilized-enzyme layer 15 which consists of the above enzymes is protected in a vertical layer as an example of the immobilized-enzyme film 13 is typical. The immobilized-enzyme layer 15 is formed by the constructing-bridge method using the bridge formation material which has a functional group, the entrapping elasticity covered with the inside of the grid of gel, or a macromolecule. The lower protective coat 14 restricts transparency of the interfering substance on the front face of an electrode as occasion demands, adhesion and stability with the ground electrode 10

(refer to drawing 9), and moreover, opening 30a is an ellipse and is presenting elliptical [of a short circle] in the vertical section direction of the sensor electrode holder 5 in the transection direction (refer to drawing 6). Although preservation liquid becomes easy to permeate into opening 30a by this in case covering 3 is attached in the main part 2 of a measuring instrument (i.e., when flooding the enzyme sensor 18 in the sensor electrode holder 5 with the preservation liquid in covering 3), a foam stops being able to remain in opening 30a easily. In addition, since the point of the sensor electrode holder 5 is a smooth convex configuration (letter of a curve), insertion into covering 3 is easy.

[0024] Moreover, the sensor electrode-holder portion 30 has the shape of a cross-section semicircle from which the opening 30a side serves as a convex configuration, and the sensor electrode-holder portion 34 has the cross-section configuration of low curvature from the sectional curvature of a flat surface or a portion 30 so that drawing 9 may show. For this reason, the selection width of face of the method which a sample does not disperse a sample around opening 30a in a credit beam case directly, and supplies a sample to opening 30a becomes large, and it is user-friendly for the induction section 21 of an enzyme sensor 18. Furthermore, since the configuration of the posterior part (sensor electrode-holder portions 31 and 32) of the sensor electrode holder 5 is unsymmetrical so that drawing 7 and drawing 8 may show, the incorrect insertion of the sensor electrode holder 5 to the main part 2 of a measuring instrument can be prevented.

[0025] It is attached in the main part 2 of a measuring instrument removable at drawing 10 , and the example of structure of the point of covering 3 and the main part 2 of a measuring instrument equipped with the preservation liquid stowage which contains preservation liquid (built-in state of the sensor electrode holder 5) is shown. Covering 3 consists of covering up 3a and covering lower 3b, and covering lower 3b of covering up 3a is here, removable respectively to covering up 3a to the main part 2 of a measuring instrument. the preservation liquid in covering 3 -- a cartridge 40 and packing -- it holds in the building envelope formed by the member 41 a cartridge 40 and packing -- a member 41 is pinched and fixed between stopper 42a of attachment in covering up 3a, and stopper 42b of attachment in covering lower 3b therefore, packing -- disclosure of preservation liquid is effectively prevented by work of a member 41 and Stoppers 42a and 42b, and waterproofness improves moreover, a cartridge 40 and packing -- the position is uniformly held in the case of insertion and secession of the sensor electrode holder 5 into covering 3 of attachment and detachment of as opposed to [in a member 41] the main part 2 of a measuring instrument by work of Stoppers 42a and 42b of covering 3, i.e., the time Furthermore, since covering up 3a and covering lower 3b are removable, it becomes easy a supplement and exchanging them washing of a cartridge 40 and the preservation liquid in a cartridge 40.

[0026] packing -- in order to insert the sensor electrode holder 5, while the point of the sensor electrode holder 5 and the crevice of an approximation configuration are formed in the center section of the member 41, the slit section which follows this crevice is formed, and the slit section is opened and closed by the existence of the sensor electrode holder 5 Preferably, if the slit section is equipped with the contraction ring 43 as an object for opening-and-closing assistance, sealing nature when the slide section closes will improve. By these composition, it not only can prevent that foreign matters, such as dust, invade in preservation liquid from the exterior, but it can prevent the leakage by the exterior of preservation liquid effectively.

[0027] in addition, packing -- the slit section of a member 41 -- packing -- after manufacturing a member 41 -- you may form -- packing -- a member 41 is used as a member 2 ****, and this 2 division member is doubled, and it presses fit in covering 3, is made into a free portion except the pressing section, and is good also considering this free portion as the slit section In order to make it the sensor electrode holder 5 not secede from the main part 2 of a measuring instrument simply by the desorption to the main part 2 of a measuring instrument of covering 3, the fastener 51 is formed in the nose-of-cam side of the main part 2 of a measuring instrument. The enzyme sensor 18 in the sensor electrode holder 5 is stabilized by changing into a firm-measurement state also including the time of un-measuring, and the sensor electrode holder 5 ceases to separate from it from the main part 2 of a measuring instrument in the grade which touches lightly except operating the sensor electrode holder 5 at the time of exchange of an enzyme

sensor 18, or is washed by certainly fixing the sensor electrode holder 5 to the main part 2 of a measuring instrument by the fastener 51 therefore.

[0028] Next, while detecting whether the main part 2 of a measuring instrument is equipped with the sensor electrode holder 5 (namely, enzyme sensor 18), the example equipped with a detection means to detect whether the main part 2 of a measuring instrument is equipped with covering 3 is shown in drawing 11 . However, since structures other than a detection means are the same as the example shown in drawing 10 , the same sign is given to the same element and the explanation is omitted. In this example, the measuring circuit substrate 60 is extended to near the edge of the sensor electrode holder 5 in the main part of measuring instrument 2 interior. Into the portion corresponding to the engagement section of the main part 2 of a measuring instrument and covering 3 of this circuit board 60 A reed relay 61 is attached and into the portion corresponding to the edge of the sensor electrode holder 5 A microswitch 62 is attached and the connector 64 electrically connected with an enzyme sensor 18 is attached in the portion which meets the connector area 22 of the enzyme sensor 18 which projects from the sensor electrode holder 5 further. On the other hand, the magnet 63 is laid under the corresponding point of covering 3.

[0029] If such a detection means is established and the main part 2 of a measuring instrument will be equipped with covering 3, a reed relay 61 will be turned on [it] by the magnetic action of a magnet 63, and being equipped with covering 3 will be detected. Since it can consider as a measurement start state automatically by removing covering 3 using this, it becomes unnecessary to form a measurement start switch in the main part 2 of a measuring instrument. Moreover, if the sensor electrode holder 5 is inserted in the main part 2 of a measuring instrument, while the connector area 22 of an enzyme sensor 18 will be connected to the connector 64 of the circuit board 60, a microswitch 62 is turned on [it] with the sensor electrode holder 5, and being equipped with the sensor electrode holder 5 is detected. For this reason, when it equips with covering 3 in the state where the sensor electrode holder 5 is not attached in the main part 2 of a measuring instrument (i.e., when having not flooded the enzyme sensor 18 with the preservation liquid in covering 3), cautions to that effect can be urged.

[0030] By establishing such a detection means, it is certainly detectable un-equipping [of covering 3 or the sensor electrode holder 5]. In addition, in order to report the existence of wearing based on a detection signal, that may be displayed on the display 6 of the main part 2 of a measuring instrument, or you may pronounce at a buzzer etc. If operation of the measuring instrument 1 constituted as mentioned above is described briefly, on the occasion of measurement, covering 3 is first removed from the main part 2 of a measuring instrument, after checking the display or audible tone which tells a measurable thing, opening 30a of the sensor electrode holder 5 will be immersed into the sample paid in the container, or a sample will be continuously hung on opening 30a. And after checking a display or audible tone of a measurement end, measurement operation is ended, and a measurement result is checked by display. Then, afterwater etc. washes opening 30a of the sensor electrode holder 5, i.e., near [induction section 21] an enzyme sensor 18, the main part 2 of a measuring instrument is equipped with covering 3.

[0031]

[Effect of the Invention] Since the carried type measuring instrument of this invention is constituted as explained above, it has the following effect.

(1) The main part of a measuring instrument equipped with the sensor electrode holder, measuring circuit, and power supply section which built in the enzyme sensor in the measuring instrument according to claim 1, Since it consists of covering equipped with the preservation liquid stowage which is attached in the main part of a measuring instrument removable so that the enzyme sensor which projects from this main part of a measuring instrument may be covered, and contains the preservation liquid for enzyme sensors, If a sensor electrode holder (namely, enzyme sensor) appears, and it will be in a measurable state, if covering is removed from the main part of a measuring instrument at the time of measurement, and covering is conversely attached in the main part of a measuring instrument An enzyme sensor is not only maintainable to a fixed damp or wet condition, but it can be immersed into the preservation liquid in covering of an enzyme sensor, and operability improves.

(2) It comes to carry out 2 ***f coverings, and a cartridge and a pac g member can take out a cartridge independently in the state of a power supply OFF by supposing that desorption is carried out by division of covering and fixation of divided covering is automatically fixed in covering (claim 2 publication). Therefore, addition and exchange of preservation liquid, and washing of a cartridge can be performed easily. And in the state of a power supply OFF, since the handling of preservation liquid is possible, it is advantageous at safety aspects, such as prevention of a short circuit.
(3) It becomes possible to make the enzyme reaction to a sample perform efficiently by being the planar type enzyme sensor by which the enzyme sensor formed the hydrogen peroxide electrode on the insulating substrate, and formed the immobilized-enzyme layer on this hydrogen peroxide electrode (claim 3 publication). Moreover, it becomes possible to process easily the form of the enzyme sensor according to the purpose of a measuring instrument.
(4) By containing an enzyme sensor with a surface-protection film in a sensor electrode holder (claim 4 publication), it is possible to be able to protect an enzyme sensor from the physical shock from the outside, and to protract the life of an enzyme sensor. Moreover, with a surface-protection film, the buffer matter which affects an enzyme reaction can be filtered and stable and exact measurement is attained.
(5) It is fixed to the O ring formed in the sensor electrode holder, and by carrying out adhesion fixation at an enzyme sensor at the time of receipt of the enzyme sensor into a sensor electrode holder (claim 5 publication), the degree of adhesion of a surface-protection film to an enzyme sensor becomes always fixed, and the stable measurement of a surface-protection film is attained. Moreover, the waterproofing operation inside an enzyme sensor is obtained by using an O ring, and reinforcement of an enzyme sensor and stabilization can be realized. Furthermore, since the O ring has these two work, it can realize stabilization of an enzyme sensor with easy structure.
(6) According to the above effects, the good carried type measuring instrument of the operability and reliability which turned a miniaturization and lightweight as a whole can be offered.

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TECHNICAL FIELD

[Industrial Application] this invention relates to the carried type measuring instrument for biochemistry which used the immobilized-enzyme sensor.

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PRIOR ART

[Description of the Prior Art] An enzyme can use it now by the outstanding substrate specificity and outstanding immobilization technology, being stabilized repeatedly, utilization is promoted, and, as for the present age, the food-stuff-industry field, the clinical test field, etc. are used broadly. In the inspection field, it is used for detection and the fixed quantity of the special material in the composite sample using the enzyme, and two kinds of methods as follows are mainly put in practical use. The one method is the method of changing the amount of enzyme reactions into color tone change by mixture with an enzyme and a color reagent, detecting this color tone change optically, and measuring special material (substrate), and other methods are the methods of detecting electrochemically an enzyme and the matter fluctuated in connection with an enzyme reaction combining an electrode, and measuring special material (substrate) from the quantity of electricity change.

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EFFECT OF THE INVENTION

[Effect of the Invention] Since the carried type measuring instrument of this invention is constituted as explained above, it has the following effect.
(1) The main part of a measuring instrument equipped with the sensor electrode holder, measuring circuit, and power supply section which built in the enzyme sensor in the measuring instrument according to claim 1, Since it consists of covering equipped with the preservation liquid stowage which is attached in the main part of a measuring instrument removable so that the enzyme sensor which projects from this main part of a measuring instrument may be covered, and contains the preservation liquid for enzyme sensors, If a sensor electrode holder (namely, enzyme sensor) appears, and it will be in a measurable state, if covering is removed from the main part of a measuring instrument at the time of measurement, and covering is conversely attached in the main part of a measuring instrument An enzyme sensor is not only maintainable to a fixed damp or wet condition, but it can be immersed into the preservation liquid in covering of an enzyme sensor, and operability improves.
(2) It comes to carry out 2 ****s of coverings, and a cartridge and a packing member can take out a cartridge independently in the state of a power supply OFF by supposing that desorption is carried out by division of covering and fixation of divided covering is automatically fixed in covering (claim 2 publication). Therefore, addition and exchange of preservation liquid, and washing of a cartridge can be performed easily. And in the state of a power supply OFF, since the handling of preservation liquid is possible, it is advantageous at safety aspects, such as prevention of a short circuit.
(3) It becomes possible to make the enzyme reaction to a sample perform efficiently by being the planar type enzyme sensor by which the enzyme sensor formed the hydrogen peroxide electrode on the insulating substrate, and formed the immobilized-enzyme layer on this hydrogen peroxide electrode (claim 3 publication). Moreover, it becomes possible to process easily the form of the enzyme sensor according to the purpose of a measuring instrument.
(4) By containing an enzyme sensor with a surface-protection film in a sensor electrode holder (claim 4 publication), it is possible to be able to protect an enzyme sensor from the physical shock from the outside, and to protract the life of an enzyme sensor. Moreover, with a surface-protection film, the buffer matter which affects an enzyme reaction can be filtered and stable and exact measurement is attained.
(5) It is fixed to the O ring formed in the sensor electrode holder, and by carrying out adhesion fixation at an enzyme sensor at the time of receipt of the enzyme sensor into a sensor electrode holder (claim 5 publication), the degree of adhesion of a surface-protection film to an enzyme sensor becomes always fixed, and the stable measurement of a surface-protection film is attained. Moreover, the waterproofing operation inside an enzyme sensor is obtained by using an O ring, and reinforcement of an enzyme sensor and stabilization can be realized. Furthermore, since the O ring has these two work, it can realize stabilization of an enzyme sensor with easy structure.
(6) According to the above effects, the good carried type measuring instrument of the operability and reliability which turned a miniaturization and lightweight as a whole can be offered.

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] Although in the case of the latter method it may mix with the sample solution and an enzyme may be used, since equipment becomes large-scale, the combination of fixation and thin-film-izing of the enzyme which can miniaturize equipment for general uses, and an electrode is used. In this case, it is necessary to keep constant an immobilized-enzyme film and the both sides of adhesion of an electrode, and the damp or wet condition of the sensor section.

[0004] This is for keeping constant the amount of diffusion to the immobilized-enzyme layer of the measuring object matter in a liquid sample (substrate), and the amount of diffusion on the front face of an electrode of the matter fluctuated in connection with an enzyme reaction, and stabilizing a measurement result. On the contrary, when the damp or wet condition of an enzyme film, the adhesion of an electrode and an enzyme film, and an electrode changes, it is to change a measurement result as a result. Then, although the attempt of the improvement in operability, such as forming an enzyme film wearing fixture, is made in order to maintain uniformly the electrode at the time of enzyme film wearing, and the adhesion of an enzyme film, in order that a user may exchange until it gets tired, the adhesion instability by poor wearing is not avoided.

[0005] Moreover, in order to maintain the immobilized-enzyme sensor section at a fixed damp or wet condition, the method of preparing the sensor section in a flow cell and supplying a sample and preservation liquid has been used, and a pump is also needed in addition to a flow cell. Anyway, for maintenance of waterproofing and preservation liquid, equipment became large and became expensive. Moreover, the constant rate needed to be isolated preparatively also about the sample, and the sensor needed to be supplied, or the sample needed to be brought together in the container, the sensor needed to be immersed, and the pretreatment treatment of a sample was required.

[0006] On the other hand, the proposal which maintains the damp or wet condition of an enzyme sensor is made by making a sponge-like porosity object absorb preservation liquid, and contacting this porosity object on the induction front face of an immobilized-enzyme sensor in recent years (for example, refer to JP,4-43947,A and JP,64-50,U). In this case, although portability improved by miniaturization, the diffusion limit film is separated, it is necessary to attach a diffusion limit film for every measurement, and it cannot be said that operability and stability are enough. Furthermore, the pressure-welding state of an electrode and a water absorption object tends to change with elastic change of an elasticity water absorption object, circulation of preservation liquid is also hard to be performed, and receipt volume also decreases. Moreover, it will be in a seal state at the time of preservation, and the pressure variation by the temperature change etc. will produce it.

[0007] Therefore, this invention was made paying attention to the above conventional troubles, and aims at offering the carried type measuring instrument which mainly realizes miniaturization, improvement in operability, improvement in output stability, and waterproof improvement.

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MEANS

[Means for Solving the Problem] In order to attain the aforementioned purpose, the carried type measuring instrument of this invention according to claim 1 The main part of a measuring instrument equipped with the sensor electrode holder, measuring circuit, and power supply section which built in the enzyme sensor, It is attached in the main part of a measuring instrument removable so that the enzyme sensor which projects from this main part of a measuring instrument may be covered. It consists of covering equipped with the preservation liquid stowage which contains the preservation liquid for enzyme sensors. The aforementioned covering connotes preservation liquid in the closed space formed by the cartridge prepared in the interior, and the packing member. The aforementioned sensor electrode holder penetrates a packing member, is inserted into covering, and, thereby, is characterized by touching the preservation liquid in covering of the enzyme sensor in a sensor electrode holder.

[Translation done.]

OPERATION

[Function] In a measuring instrument according to claim 1, if a sensor electrode holder (namely, enzyme sensor) appears, and it will be in a measurable state, if covering is removed from the main part of a measuring instrument at the time of measurement, and covering is conversely attached in the main part of a measuring instrument, an enzyme sensor is not only maintainable to a fixed damp or wet condition, but it can be immersed into the preservation liquid in covering of an enzyme sensor, and operability will improve.

[0010] It comes to carry out 2 ****s of coverings, and a cartridge and a packing member can take out a cartridge independently in the state of a power supply OFF by supposing that desorption is carried out by division of covering and fixation of divided covering is automatically fixed in covering (claim 2 publication). Therefore, it is advantageous at safety aspects, such as prevention of addition and exchange of preservation liquid, and washing of a cartridge not only being performed easily but a short circuit.

[0011] It becomes possible to make the enzyme reaction to a sample perform efficiently by being the planar type enzyme sensor by which the enzyme sensor formed the hydrogen peroxide electrode on the insulating substrate, and formed the immobilized-enzyme layer on this hydrogen peroxide electrode (claim 3 publication). Moreover, it becomes possible to process easily the form of the enzyme sensor according to the purpose of a measuring instrument. By containing an enzyme sensor with a surface-protection film in a sensor electrode holder (claim 4 publication), it is possible to be able to protect an enzyme sensor from the physical shock from the outside, and to protract the life of an enzyme sensor. Moreover, with a surface-protection film, the buffer matter which affects an enzyme reaction can be filtered and stable and exact measurement is attained.

[0012] It is fixed to the O ring formed in the sensor electrode holder, and by carrying out adhesion fixation at an enzyme sensor at the time of receipt of the enzyme sensor into a sensor electrode holder (claim 5 publication), the degree of adhesion of a surface-protection film to an enzyme sensor becomes always fixed, and the stable measurement of a surface-protection film is attained. Moreover, the waterproofing operation inside an enzyme sensor is obtained by using an O ring, and reinforcement of an enzyme sensor and stabilization can be realized. Furthermore, since the O ring has these two work, it can realize stabilization of an enzyme sensor with easy structure.

[0013] By the above, it becomes the good carried type measuring instrument of the operability and reliability which turned a miniaturization and lightweight as a whole.

[Translation done.]

EXAMPLE

[Example] Hereafter, the carried type measuring instrument of this invention is explained based on an example. The exterior side view of the measuring instrument concerning the one example is shown in drawing 1 , and an appearance side elevation is shown in drawing 2 . This measuring instrument 1 is attached in the main part 2 of a measuring instrument removable so that the sensor electrode holder which projects from the main part 2 of a measuring instrument equipped with the sensor electrode holder, measuring circuit, and power supply section which built in the enzyme sensor, and this main part 2 of a measuring instrument may be covered, and it consists of covering 3 equipped with the preservation liquid stowage which contains the preservation liquid for enzyme sensors. The main part 2 of a measuring instrument has a display 6 and the cell case 7, and an internal measuring circuit consists of electronic parts, such as a computing element and a buzzer, including various kinds. Moreover, if covering 3 is removed from the main part 2 of a measuring instrument as shown in drawing 3 and drawing 4 , the sensor electrode holder 5 which built in the enzyme sensor will appear from the main part 2 of a measuring instrument.

[0015] The enzyme sensor built in the sensor electrode holder 5 is the unification planar type enzyme sensor 18 which consists of a ground electrode 10 attached in the sensor electrode holder 5 as shown in drawing 5 , and an immobilized-enzyme film 13 by which the laminating was carried out on this ground electrode 10. Two example ** of a degree and ** are mentioned as a ground electrode 10.

** Voltage -> use the field-effect transistor as a current sensing element. In this case, the insulated gate section is prepared in the outermost part, an immobilized-enzyme layer is formed after the exterior, and pH change accompanying an enzyme reaction is caught as gate-voltage change (simultaneously changed into drain current change).

** Current -> use planar type an oxygen electrode and a hydrogen peroxide electrode as a voltage sensing element. In this case, an immobilized-enzyme layer is formed in an induction section front face, and the change in oxygen and the hydrogen peroxide accompanying an enzyme reaction is caught as oxidation-current change of a ground electrode. Although various kinds of metals are used as an electrode, gold (Au), platinum (Pt), silver (Ag), etc. are mainly used for a reference pole pair pole, using platinum (Pt) as an operation pole.

[0016] The following ** - ** are illustrated as an enzyme used for an enzyme sensor 18.

** Glucose oxidizing enzyme (GOD)

It is accompanied by consumption (reduction) of 2OGlucose+O2 -> gluconic-acid +H2 oxygen (O2), generating (increase) of a hydrogen peroxide (H2 O2), and generating (pH reduction) of a gluconic acid.

** Lactic-acid oxidizing enzyme (LOD)

It is accompanied by consumption (reduction) of 2OL-Lactate+O2 -> Pyruvate+H2 oxygen (O2), and generating (increase) of a hydrogen peroxide (H2 O2).

** Generating (increase in pH by reduction in hydrogen ion concentration) and CO2 of urease urea +H2 O->2NH3+CO2 ammonia It is accompanied by the increase in gas.

** It is accompanied by consumption (reduction) of uricase uric-acid +O2+2H2 O-> allantoin +H2

O+CO2 oxygen (O2), generating (increase) of a hydrogen peroxide (H2), and the increase in CO2 gas.

[0017] The sandwich structure from which the immobilized-enzyme layer 15 which consists of the above enzymes is protected in a vertical layer as an example of the immobilized-enzyme film 13 is typical. The immobilized-enzyme layer 15 is formed by the constructing-bridge method using the bridge formation material which has a functional group, the entrapping elasticity covered with the inside of the grid of gel, or a macromolecule. The lower protective coat 14 restricts transparency of the interfering substance on the front face of an electrode as occasion demands, adhesion and stability with the ground electrode 10 and the immobilized-enzyme layer 15 are required for it, and an acetyl cellulose, ion convertibility film material, etc. are used. Adhesion and a mechanical strength with the immobilized-enzyme layer 15 are required for the up protective coat 16 for the purpose of protection of the immobilized-enzyme layer 15 and a diffusion limit of the substrate to the immobilized-enzyme layer 15.

[0018] In formation of these each class, a thin uniform film can be obtained by using a dip coating method and the spin coat method. For example, the lower protective coat 14 trickles an acetyl-cellulose thin film (solvent composition; acetone : cyclohexanone = 3:1) into a metal electrode 12 5%, and by 2000rpm, it is made to rotate for 5 seconds and it can form it. The immobilized-enzyme layer 15 carries out the spin coat of the enzyme solution which mixed 0.5% glutaraldehyde solution adjusted by the 0.1M phosphate buffer solution (pH 7.0), and the enzyme like the lower protective coat 14, and can form it. The up protective coat 16 carries out the DIP coat of the acetyl-cellulose thin film (solvent composition; acetone : ethanol = 1:1) by 1 cm/sec 2.5%, and can be formed.

[0019] In this example, the planar type hydrogen peroxide electrode as a ground electrode 10 forms alternatively the thin film of for example, platinum, gold, and silver in the front face of the insulating film 11 of a ceramic or a resin film as a metal electrode 12. Moreover, the immobilized-enzyme film 13 sticks separately the surface-protection film 17 which consists of a nylon grid, a polycarbonate, etc. on the up protective coat 16, in order to carry out bridge formation fixation of GOD or the LOD as an immobilized-enzyme layer 15 and to strengthen the function of the up protective coat 16 further.

[0020] The example of structure of the sensor electrode holder 5 which built in such an enzyme sensor 18 is shown in drawing 6 (plan), drawing 7 (side elevation), drawing 8 (drawing of longitudinal section), and drawing 9 (cross section in line A-A of drawing 8). As for the planar type enzyme sensor 18, it is contained except the induction section 21 and connector area 22 in the sensor electrode holder 5. It becomes unnecessary to carry out additional wearing of the protective coat etc. at the time of exchange of an enzyme sensor 18, and a measurement start by really containing the enzyme sensor 18 in the sensor electrode holder 5. And since what is necessary is just to exchange the whole sensor electrode holder 5 in order to exchange an enzyme sensor 18, the adhesion of the electrode front face and enzyme film in an enzyme sensor 18 becomes fixed, without being influenced by exchange work. Moreover, since a connector area 22 will be connected to the circuit in the main part 2 of a measuring instrument if the connector area 22 of an enzyme sensor 18 has projected from the sensor electrode holder 5 and the sensor electrode holder 5 is inserted in the main part 2 of a measuring instrument, it becomes unnecessary to wire using lead wire etc., operability, such as exchange work, improves, and the reliability of connection also becomes high.

[0021] As the sensor electrode holder 5 is shown in drawing 8 , while being screwed in the portion 30 which has opening 30a (refer to drawing 6) corresponding to the induction section 21 of an enzyme sensor 18, and this portion 30 The portion 31 which has the wearing section (not shown) equipped with the O ring for waterproofing (not shown) in order to prevent invasion of the water to the main part 2 of a measuring instrument, a foreign matter, etc., It consists of the portion 32 which positions and fixes the connector area 22 of an enzyme sensor 18 with a portion 31, a portion 33 which positions the induction section 21 of an enzyme sensor 18 to convex between portions 30, and a portion 34 which fixes near [induction section 21] an enzyme sensor 18 with a portion 33. In addition, these sensor electrode-holder portions 30-34 can prevent permeation of the sample into the sensor electrode holder 5, a wash water, etc. by carrying out welding fixation, for example.

[0022] In drawing 9 , it carries adhesion fixation of the surface-protection film 17 at the induction section 21 of an enzyme sensor 18 while it inserts an enzyme sensor 18 and the sensor electrode-holder portion 33 one by one and fixes these in the sensor electrode-holder portion 34, after adhesion fixation is carried out at O ring 38 and the surface-protection film 17 of an enzyme sensor 18 attaches the surface-protection film 17 in the sensor electrode-holder portion 30. O ring 38 can protect permeation of the sample from opening 30a of the sensor electrode-holder portion 30 to into the sensor electrode holder 5, a wash water, etc.

[0023] Opening 30a of the sensor electrode-holder portion 30 is a earthenware mortar configuration (refer to drawing 9), and moreover, opening 30a is an ellipse and is presenting elliptical [of a short circle] in the vertical section direction of the sensor electrode holder 5 in the transection direction (refer to drawing 6). Although preservation liquid becomes easy to permeate into opening 30a by this in case covering 3 is attached in the main part 2 of a measuring instrument (i.e., when flooding the enzyme sensor 18 in the sensor electrode holder 5 with the preservation liquid in covering 3), a foam stops being able to remain in opening 30a easily. In addition, since the point of the sensor electrode holder 5 is a smooth convex configuration (letter of a curve), insertion into covering 3 is easy.

[0024] Moreover, the sensor electrode-holder portion 30 has the shape of a cross-section semicircle from which the opening 30a side serves as a convex configuration, and the sensor electrode-holder portion 34 has the cross-section configuration of low curvature from the sectional curvature of a flat surface or a portion 30 so that drawing 9 may show. For this reason, the selection width of face of the method which a sample does not disperse a sample around opening 30a in a credit beam case directly, and supplies a sample to opening 30a becomes large, and it is user-friendly for the induction section 21 of an enzyme sensor 18. Furthermore, since the configuration of the posterior part (sensor electrode-holder portions 31 and 32) of the sensor electrode holder 5 is unsymmetrical so that drawing 7 and drawing 8 may show, the incorrect insertion of the sensor electrode holder 5 to the main part 2 of a measuring instrument can be prevented.

[0025] It is attached in the main part 2 of a measuring instrument removable at drawing 10 , and the example of structure of the point of covering 3 and the main part 2 of a measuring instrument equipped with the preservation liquid stowage which contains preservation liquid (built-in state of the sensor electrode holder 5) is shown. Covering 3 consists of covering up 3a and covering lower 3b, and covering lower 3b of covering up 3a is here, removable respectively to covering up 3a to the main part 2 of a measuring instrument. the preservation liquid in covering 3 -- a cartridge 40 and packing -- it holds in the building envelope formed by the member 41 a cartridge 40 and packing -- a member 41 is pinched and fixed between stopper 42a of attachment in covering up 3a, and stopper 42b of attachment in covering lower 3b therefore, packing -- disclosure of preservation liquid is effectively prevented by work of a member 41 and Stoppers 42a and 42b, and waterproofness improves moreover, a cartridge 40 and packing -- the position is uniformly held in the case of insertion and secession of the sensor electrode holder 5 into covering 3 of attachment and detachment of as opposed to [in a member 41] the main part 2 of a measuring instrument by work of Stoppers 42a and 42b of covering 3, i.e., the time Furthermore, since covering up 3a and covering lower 3b are removable, it becomes easy a supplement and exchanging them washing of a cartridge 40 and the preservation liquid in a cartridge 40.

[0026] packing -- in order to insert the sensor electrode holder 5, while the point of the sensor electrode holder 5 and the crevice of an approximation configuration are formed in the center section of the member 41, the slit section which follows this crevice is formed, and the slit section is opened and closed by the existence of the sensor electrode holder 5 Preferably, if the slit section is equipped with the contraction ring 43 as an object for opening-and-closing assistance, sealing nature when the slide section closes will improve. By these composition, it not only can prevent that foreign matters, such as dust, invade in preservation liquid from the exterior, but it can prevent the leakage by the exterior of preservation liquid effectively.

[0027] in addition, packing -- the slit section of a member 41 -- packing -- after manufacturing a member 41 -- you may form -- packing -- a member 41 is used as a member 2 ****, and this 2 division member is

doubled, and it presses fit in covering 3, is made into a free portion except the pressing section, and is good also considering this free portion as the slit section In order to make it the sensor electrode holder 5 not secede from the main part 2 of a measuring instrument simply by the desorption to the main part 2 of a measuring instrument of covering 3, the fastener 51 is formed in the nose-of-cam side of the main part 2 of a measuring instrument. The enzyme sensor 18 in the sensor electrode holder 5 is stabilized by changing into a firm-measurement state also including the time of un-measuring, and the sensor electrode holder 5 ceases to separate from it from the main part 2 of a measuring instrument in the grade which touches lightly except operating the sensor electrode holder 5 at the time of exchange of an enzyme sensor 18, or is washed by certainly fixing the sensor electrode holder 5 to the main part 2 of a measuring instrument by the fastener 51 therefore.

[0028] Next, while detecting whether the main part 2 of a measuring instrument is equipped with the sensor electrode holder 5 (namely, enzyme sensor 18), the example equipped with a detection means to detect whether the main part 2 of a measuring instrument is equipped with covering 3 is shown in drawing 11 . However, since structures other than a detection means are the same as the example shown in drawing 10 , the same sign is given to the same element and the explanation is omitted. In this example, the measuring circuit substrate 60 is extended to near the edge of the sensor electrode holder 5 in the main part of measuring instrument 2 interior. Into the portion corresponding to the engagement section of the main part 2 of a measuring instrument and covering 3 of this circuit board 60 A reed relay 61 is attached and into the portion corresponding to the edge of the sensor electrode holder 5 A microswitch 62 is attached and the connector 64 electrically connected with an enzyme sensor 18 is attached in the portion which meets the connector area 22 of the enzyme sensor 18 which projects from the sensor electrode holder 5 further. On the other hand, the magnet 63 is laid under the corresponding point of covering 3.

[0029] If such a detection means is established and the main part 2 of a measuring instrument will be equipped with covering 3, a reed relay 61 will be turned on [it] by the magnetic action of a magnet 63, and being equipped with covering 3 will be detected. Since it can consider as a measurement start state automatically by removing covering 3 using this, it becomes unnecessary to form a measurement start switch in the main part 2 of a measuring instrument. Moreover, if the sensor electrode holder 5 is inserted in the main part 2 of a measuring instrument, while the connector area 22 of an enzyme sensor 18 will be connected to the connector 64 of the circuit board 60, a microswitch 62 is turned on [it] with the sensor electrode holder 5, and being equipped with the sensor electrode holder 5 is detected. For this reason, when it equips with covering 3 in the state where the sensor electrode holder 5 is not attached in the main part 2 of a measuring instrument (i.e., when having not flooded the enzyme sensor 18 with the preservation liquid in covering 3), cautions to that effect can be urged.

[0030] By establishing such a detection means, it is certainly detectable un-equipping [of covering 3 or the sensor electrode holder 5]. In addition, in order to report the existence of wearing based on a detection signal, that may be displayed on the display 6 of the main part 2 of a measuring instrument, or you may pronounce at a buzzer etc. If operation of the measuring instrument 1 constituted as mentioned above is described briefly, on the occasion of measurement, covering 3 is first removed from the main part 2 of a measuring instrument, after checking the display or audible tone which tells a measurable thing, opening 30a of the sensor electrode holder 5 will be immersed into the sample paid in the container, or a sample will be continuously hung on opening 30a. And after checking a display or audible tone of a measurement end, measurement operation is ended, and a measurement result is checked by display. Then, afterwater etc. washes opening 30a of the sensor electrode holder 5, i.e., near [induction section 21] an enzyme sensor 18, the main part 2 of a measuring instrument is equipped with covering 3.

[Translation done.]

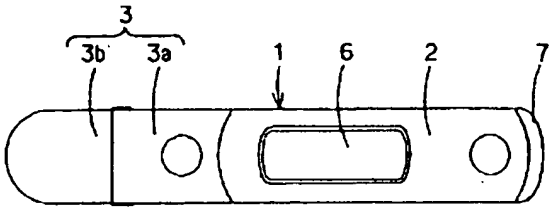
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the exterior side view of the measuring instrument concerning one example.
[Drawing 2] It is the appearance side elevation of the measuring instrument shown in drawing 1 .
[Drawing 3] It is a plan in the state where covering of the measuring instrument shown in drawing 1 was removed.
[Drawing 4] It is the side elevation of the measuring instrument shown in drawing 3 .
[Drawing 5] It is the important section cross section showing the example of structure of the enzyme sensor contained by the sensor electrode holder.
[Drawing 6] It is the plan showing the example of structure of a sensor electrode holder.
[Drawing 7] It is the side elevation of the sensor electrode holder shown in drawing 6 .
[Drawing 8] It is drawing of longitudinal section of the sensor electrode holder shown in drawing 7 .
[Drawing 9] It is a cross section in line A-A of the sensor electrode holder shown in drawing 8 .
[Drawing 10] It is drawing of longitudinal section showing the example of structure of the point of the main part of a measuring instrument in the state where it equipped with the sensor electrode holder, and covering.
[Drawing 11] It is drawing of longitudinal section showing another example of structure of the point of the main part of a measuring instrument in the state where it equipped with the sensor electrode holder, and covering.
[Description of Notations]
1 Carried Type Measuring Instrument
2 Main Part of Measuring Instrument
3 Covering
5 Sensor Electrode Holder
17 Surface-Protection Film
18 Enzyme Sensor
21 Induction Section of Enzyme Sensor
30a Opening of a sensor electrode holder
40 Cartridge
41 Packing -- Member

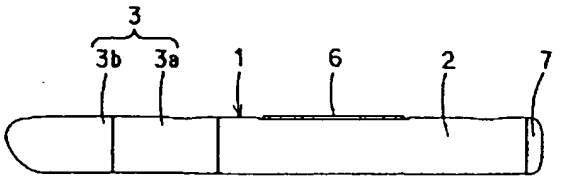
[Translation done.]

Drawing selection drawing 1



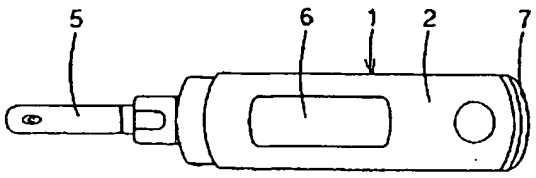
[Translation done.]

Drawing selection drawing 2



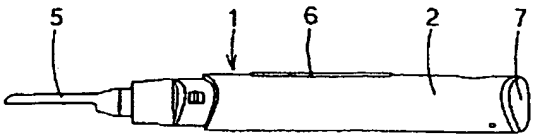
[Translation done.]

Drawing selection drawing 3



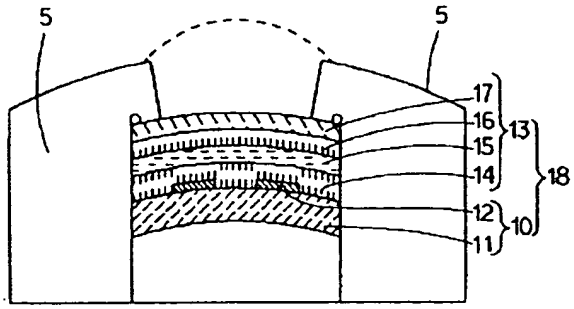
[Translation done.]

Drawing selection drawing 4



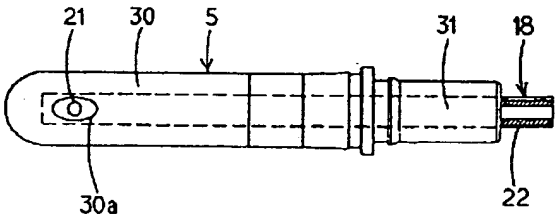
[Translation done.]

Drawing selection drawing 5



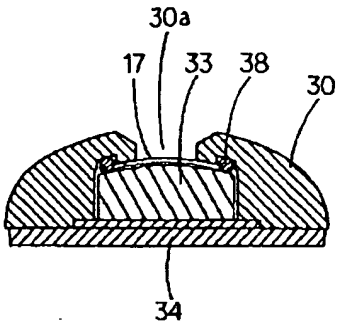
[Translation done.]

Drawing selection drawing 6



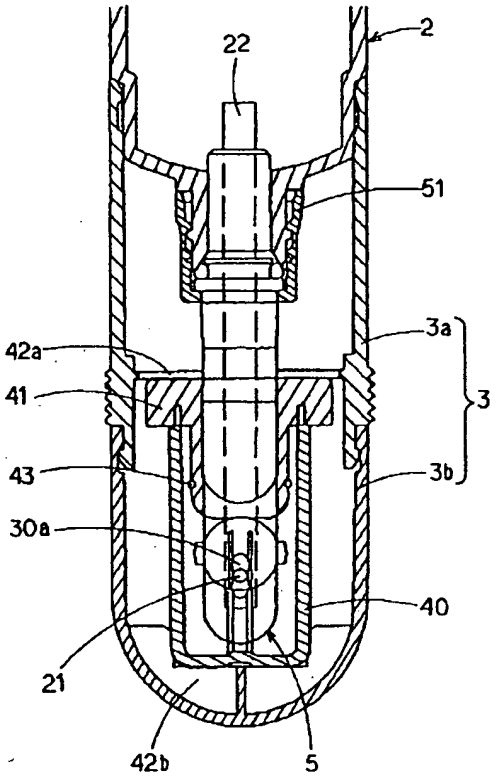
[Translation done.]

Drawing selection drawing 9



[Translation done.]

Drawing selection drawing 10



[Translation done.]